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A LINEAR RELATIONSHIP BETWEEN POSTNATAL GEOMAGNETIC ACTIVITY AND SELF-REPORTS OF EPILEPTIC SEIZURES IN YOUNG ADULTS[1]

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Summary.—To test the hypothesis of a linear relationship between the intensity of geomagnetic activity during the first two days after birth and the development of epilepsy, the responses of the item "I have had an epileptic seizure" was obtained from the Personal Philosophy Inventories of 1,453 students who had been enrolled in first-year psychology courses over a 13-yr. period. The only statistically significant effect was linear and was between the successive 10 nT (nanoTesla) increments of the intensity of geomagnetic activity during the two days after birth and the percentage of students who reported epileptic seizures. The percentage of subjects reporting a history of seizures ranged from 1% for those born when the activity was less than 10 nT to 4% for those born when this activity exceeded 40 nT.

The postnatal period is considered a period of vulnerability because of the shift in oxidative metabolism and the coerced respiratory initiation that occur immediately after parturition. Increased geomagnetic activity has been associated with decreased melatonin levels and increased seizure activity in sensitive brains (cf. Michon & Persinger, 1997, for a brief review). This study was designed to discern whether there was a linear relationship between global geomagnetic activity during the days around birth and reports of epileptic seizures by university students.

Question 113, "I have had an epileptic seizure" was extracted from the Personal Philosophy Inventories (Persinger & Makarec, 1993) of 1,453 university students who had completed this questionnaire between the years 1982 and 1996. The mean and standard deviation for the ages of the 615 men and 838 women were 23.7 yr. and 7.4 yr., respectively (range 16 years to 59 years). Thirty-seven (2.5%) of this population reported they had a seizure. There was no statistically significant association for men and women who did not report or who reported seizures ($\chi^2 = 0.31$, $p > .05$).

Average antipodal (aa) values (Mayaud, 1973) for geomagnetic activity were obtained from Mayaud (1973) or from the *Geomagnetic Indices Bulletin* (National Geophysical Data Center, Solar-Terrestrial Physics Division, 325 Broadway, Boulder, CO 80303) for each of the three days before, the day of, and for each of the five days following birth for each subject (a total

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of nine successive days). Because the birth hour was not available in the data, a variable was computed that extracted the day with the highest aa value from the day before, day of, and the day after birth. This variable, named optimal interval, was expected to maximize any effect that was present. The aa values were converted into five successive increments: 1 (0 through 10 nT), 2 (10.1 through 20 nT), 3 (20.1 through 30 nT), 4 (30.1 through 40 nT) and 5 (40.1 nT to the highest value). These increments were selected from the theoretical perspective of O'Connor and Persinger (1997, 1999).

Polynomial analysis (ONEWAY), specified for linear, quadratic, cubic, and quartic terms, was completed by SPSS software for the numbers of individuals who reported seizures as a function of the five increments of geomagnetic intensity for each of the nine days as well as for the optimal interval. The percentages of subjects who reported they had at least one seizure (sample size) for the five successive intervals of geomagnetic activity during the optimal period were 1 of 93 (1%), 2 of 396 (1%), 3 of 367 (3%), 4 of 256 (3%), and 5 of 340 (4%). Polynomial analysis indicated the relationship was linear ($F_{1,1447} = 8.49$, $p < .01$) and did not deviate significantly ($F_{3,1448} = .5$, $p > .05$) from a linear relationship. Chi-squared analysis verified that the proportion of people reporting seizures in each of the increments of geomagnetic activity deviated significantly from chance ($\chi^2 = 9.93$, $p < .04$) and was equivalent to a correlation (*phi*) of .08.

The only statistically significant relationship between geomagnetic activity and proportions of the population reporting a history of epileptic seizures on any given day was also linear. The linearity (all *df*s = 1,1448) was evident for the day after birth ($F = 5.52$, $p < .01$) and two days after birth ($F = 6.66$, $p < .01$). The percentages of subjects reporting epilepsy for each increment of geomagnetic activity during the second day after birth were 1 of 404 (2%), 2 of 460 (2%), 3 of 275 (3%), 4 of 150 (3%), and 5 of 164 (5%).

These results suggest that the brains of some neonates during the first two days after birth may be responsive to biochemical activity induced by geomagnetic activity. One would expect these changes to enhance more primary factors such as hypoxia that would ultimately contribute to cell death and the formation of epileptogenic foci (Delivoria-Papadopoulos, Younkin, & Chance, 1990). Unfortunately the birth records of the subjects in this study were not available to examine this possibility.

These results do not indicate necessarily that postnatal geomagnetic activity produced epileptic seizures. Some factor associated with this activity might contribute to the probability that epilepsy would be displayed. Because the data are retrospective and correlational, one cannot exclude the possibility that enhanced postnatal geomagnetic activity facilitated risk behav-

iours that resulted in epilepsy. The effect size was quite small and may have only epidemiological significance or relevance to population biology.

REFERENCES

DELIVORIA-PAPADOPOULOS, M., YOUNKIN, D. P., & CHANCE, B. (1990) Cerebral metabolic studies during neonatal seizures with 31-P NMR spectroscopy. In C. G. Wasterlain & P. Vert (Eds.), *Neonatal seizures*. New York: Raven. Pp. 181-189.

MAYAUD, P. N. (1973) A hundred-year series of geomagnetic data 1868–1967. *IAGA Bulletin*, No. 33.

MICHON, A. L., & PERSINGER, M. A. (1997) Experimental simulation of the effects of increased geomagnetic activity upon nocturnal seizures in epileptic rats. *Neuroscience Letters*, 224, 53-56.

O'CONNOR, R. P., & PERSINGER, M. A. (1997) Geophysical variables and behavior: LXXXII. A strong association between sudden infant death syndrome and increments of global geomagnetic activity—possible support for the melatonin hypothesis. *Perceptual and Motor Skills*, 84, 395-402.

O'CONNOR, R. P., & PERSINGER, M. A. (1999) Geophysical variables and behavior: LXXXV. Sudden infant death, bands of geomagnetic activity, and pc1 (0.2 to 5 Hz) geomagnetic micropulsations. *Perceptual and Motor Skills*, 88, 391-397.

PERSINGER, M. A., & MAKAREC, K. (1993) Complex partial epileptic-like signs as a continuum from normals to epileptics: normative data and clinical populations. *Journal of Clinical Psychology*, 49, 33-45.

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